Engineering Bi-layer Nanofibrous Conduits for Peripheral Nerve Regeneration.

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Authors: Y Zhu, A Wang, S Patel, K Kurpinski, E Diao, X Bao, G Kwong, W L Young, S Li

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Public Summary:
Trauma injuries often cause peripheral nerve damage and disability. A goal in neural tissue engineering is to develop synthetic nerve conduits for peripheral nerve regeneration having therapeutic efficacy comparable to that of autografts. Nanofibrous conduits with aligned nanofibers have been shown to promote nerve regeneration, but current fabrication methods rely on rolling a fibrous sheet into the shape of a conduit, which results in a graft with inconsistent size and a discontinuous joint or seam. In addition, the long-term effects of nanofibrous nerve conduits, in comparison with autografts, are still unknown. Here we developed a novel one-step electrospinning process and, for the first time, fabricated a seamless bi-layer nanofibrous nerve conduit: the luminal layer having longitudinally aligned nanofibers to promote nerve regeneration, and the outer layer having randomly organized nanofibers for mechanical support. Long-term in vivo studies demonstrated that bi-layer aligned nanofibrous nerve conduits were superior to random nanofibrous conduits and had comparable therapeutic effects to autografts for nerve regeneration. In summary, we showed that the engineered nanostructure had a significant impact on neural tissue regeneration in situ. The results from this study will also lead to the scalable fabrication of engineered nanofibrous nerve conduits with designed nanostructure. This technology platform can be combined with drug delivery and cell therapies for tissue engineering.

Scientific Abstract:
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